

# Linking NCEP Operational Model Development with NOAA Testbeds

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*“Where America’s Climate, Weather and Ocean Services Begin”*



# Outline

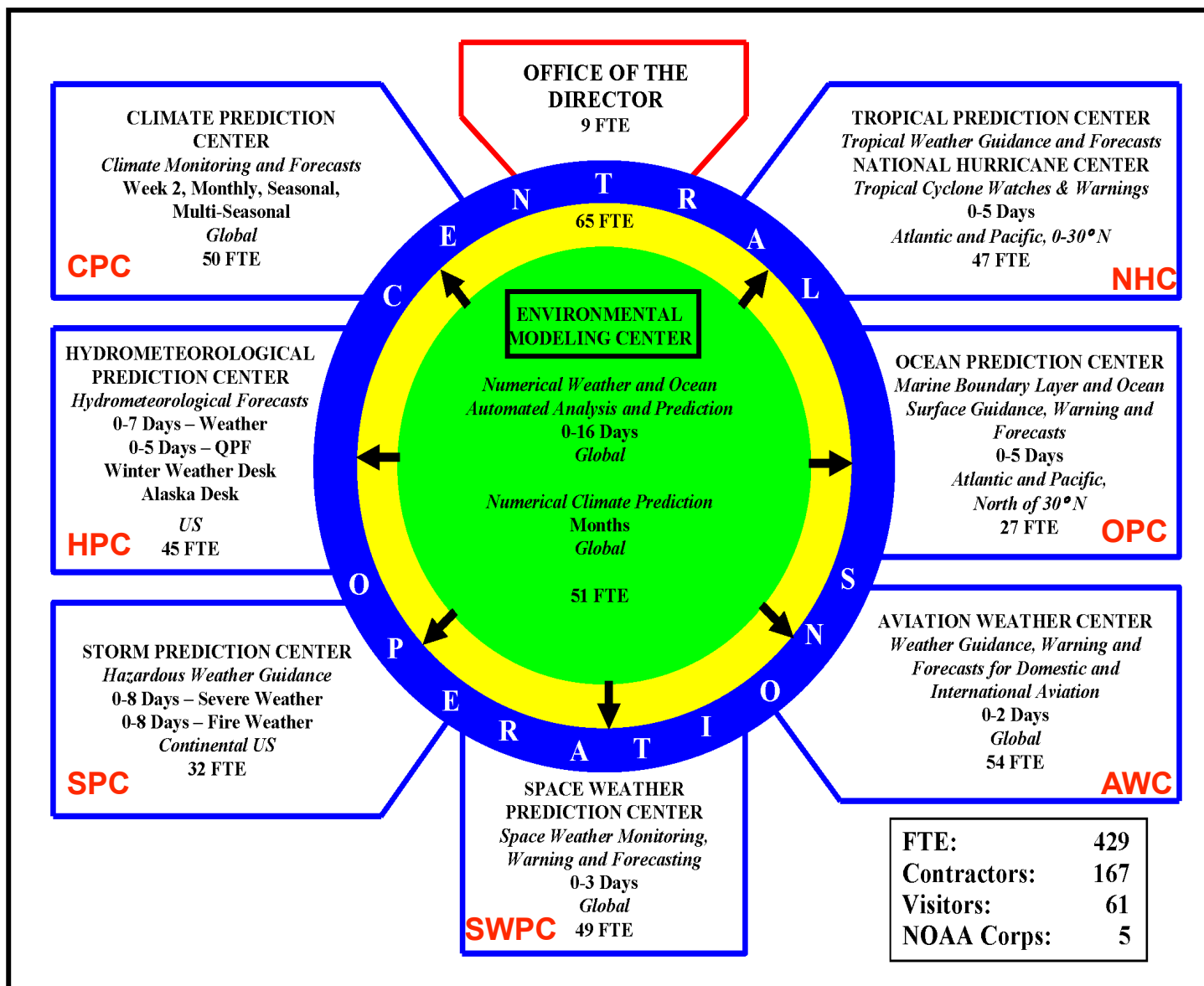
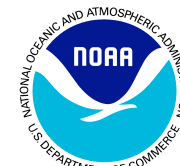


**DISCLAIMER---focused on implementing improvements to the NCEP operational numerical guidance system**

- ☐ **NCEP Structure**
- ☐ **EMC Mission**
- ☐ **Production Suite and Implementation Process**
- ☐ **Transition of Research to Operations**
- ☐ **Recommendations**



# The National Centers for Environmental Prediction





# The EMC Mission.....



## In response to operational requirements:

### ■ Develop and Enhance numerical guidance

- Improve NCEP's numerical forecast model systems via:
  - Scientific upgrades
  - Optimization
  - Additional observations

45%

### ■ Maintain operational model suite

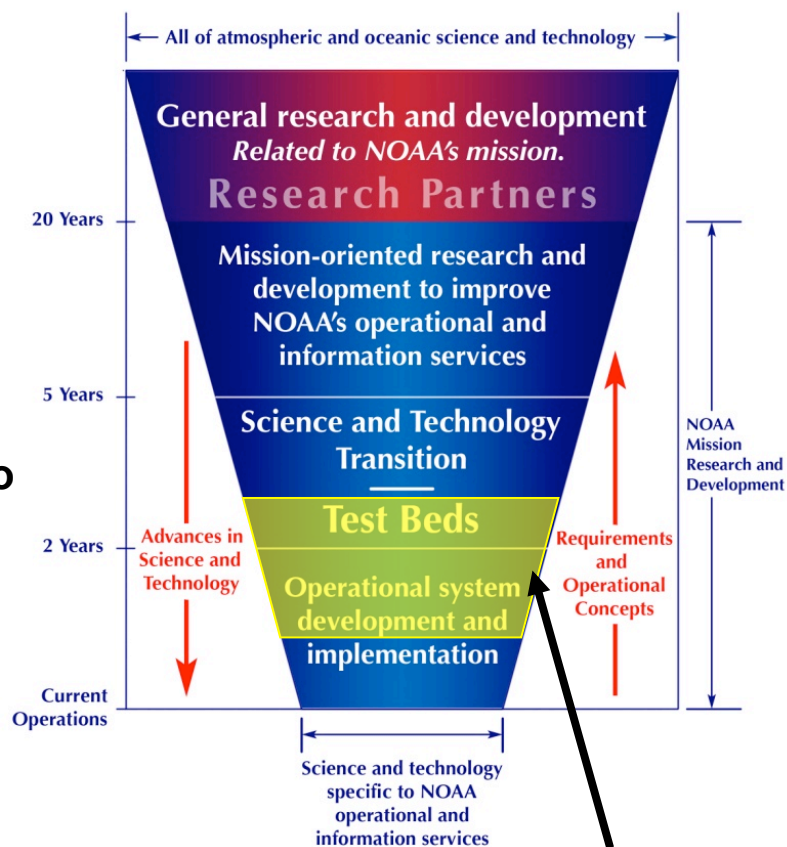
- The scientific correctness and integrity of operational forecast modeling systems
- Modify current operational system to adapt to ever-present external changes

25%

### ■ Transition operational numerical forecast models from research to operations

- Transform & integrate
  - Code
  - Algorithms
  - Techniques
- Manages and executes transition process including technical and system performance review before implementation

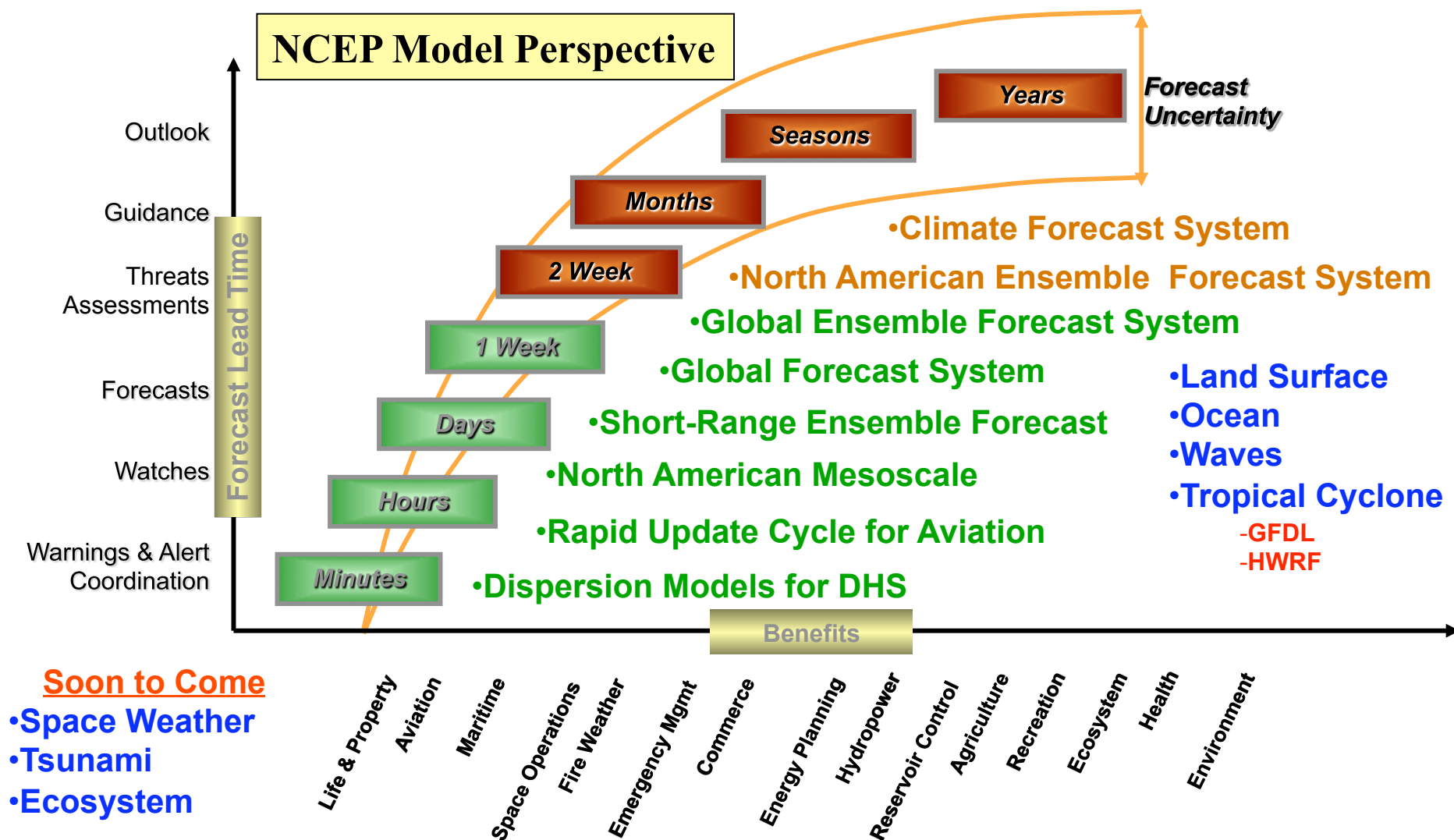
30%



**EMC location  
within the funnel**

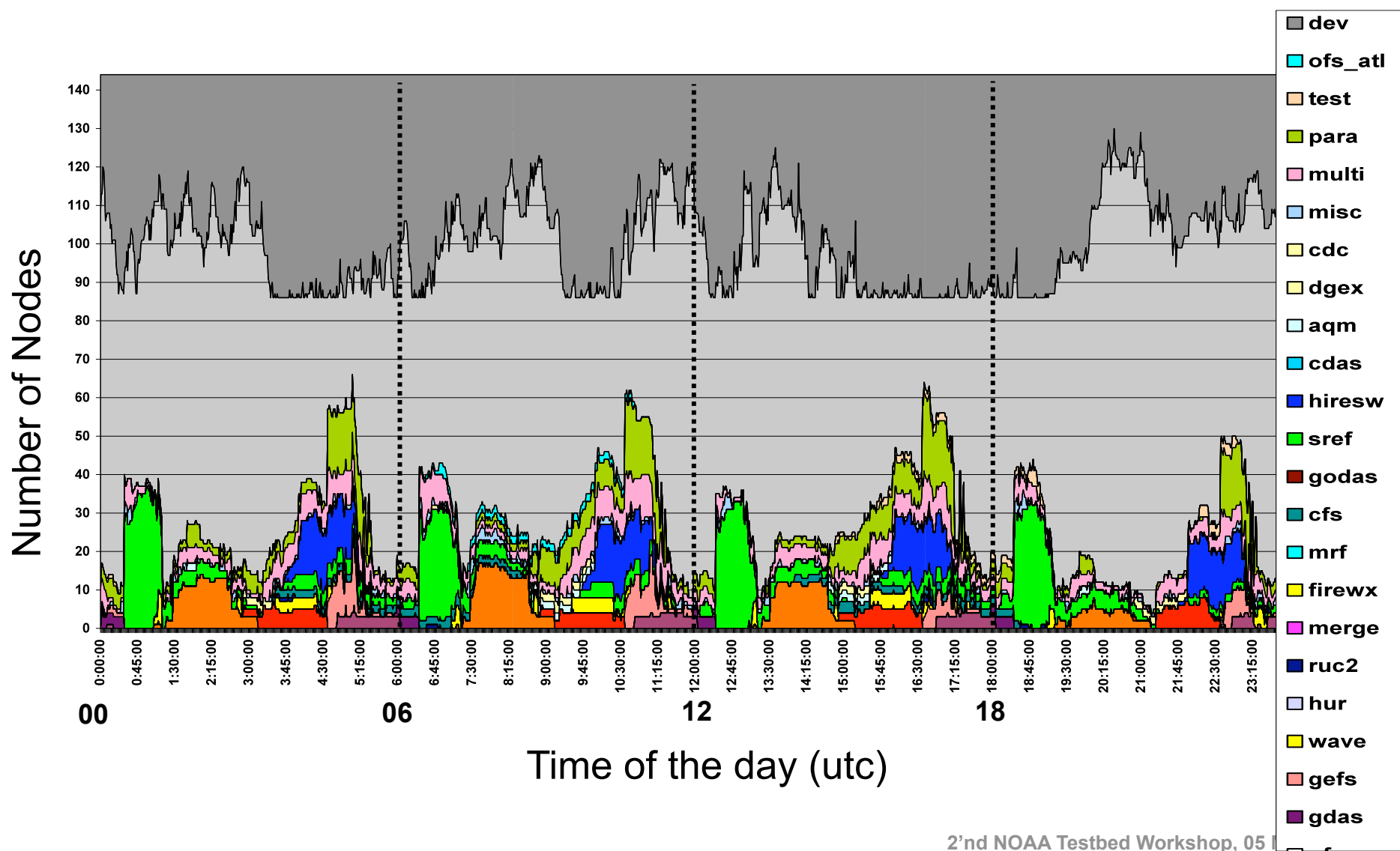
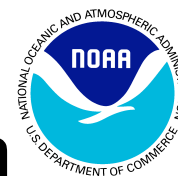


# “Foundational” NOAA/NWS Operational Numerical Guidance Spanning Weather and Climate



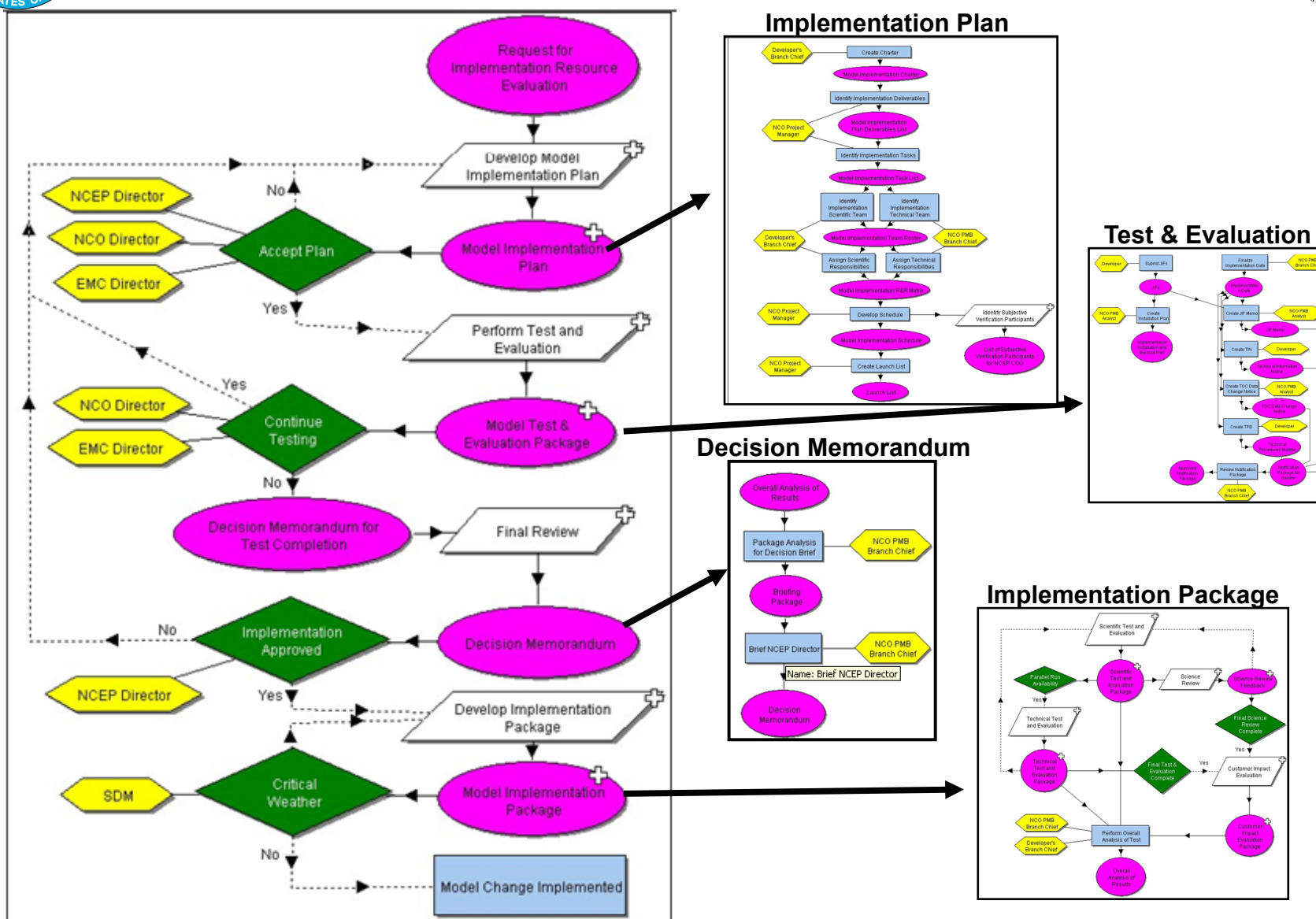


# Operational Production Suite Profile on the High Performance Computing System





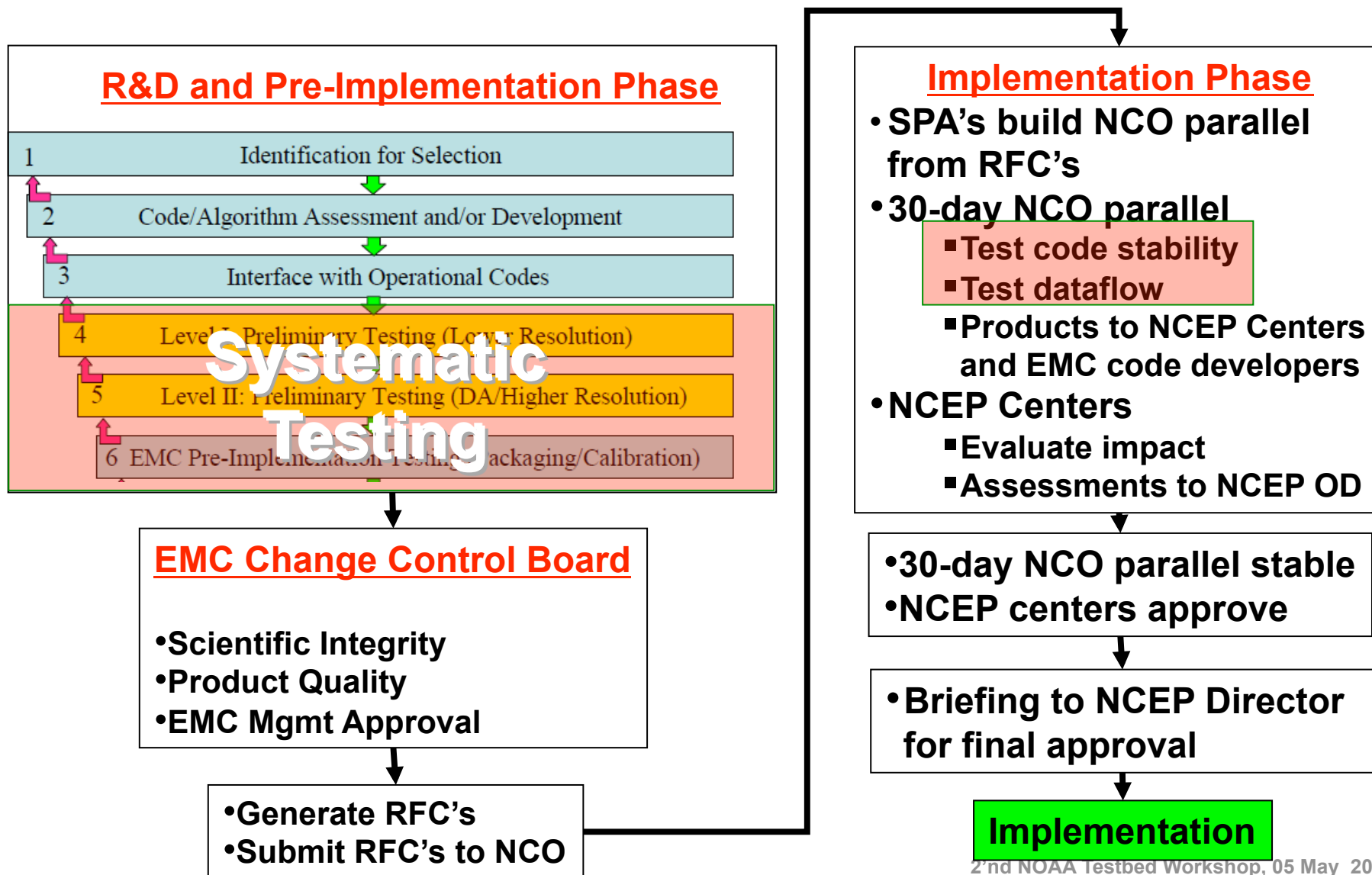
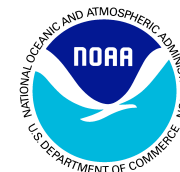
# Process to Implement Major Upgrades to The NCEP Model Production Suite







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# Apply Implementation Processes to GFS/GSI December 2009 Upgrade...



## □ Adding new observation data sources.

- **Tropical storm pseudo sea-level pressure obs**
- NOAA19 hirs/4, AMSU-A, & MHS brightness temp obs
- NOAA18 sbuv/2. Monitor N19 GOME, and OMI ozone (no assimilation)
- RARS (currently only EARS) 1B data
- EUMETSAT-9 atm motion vectors

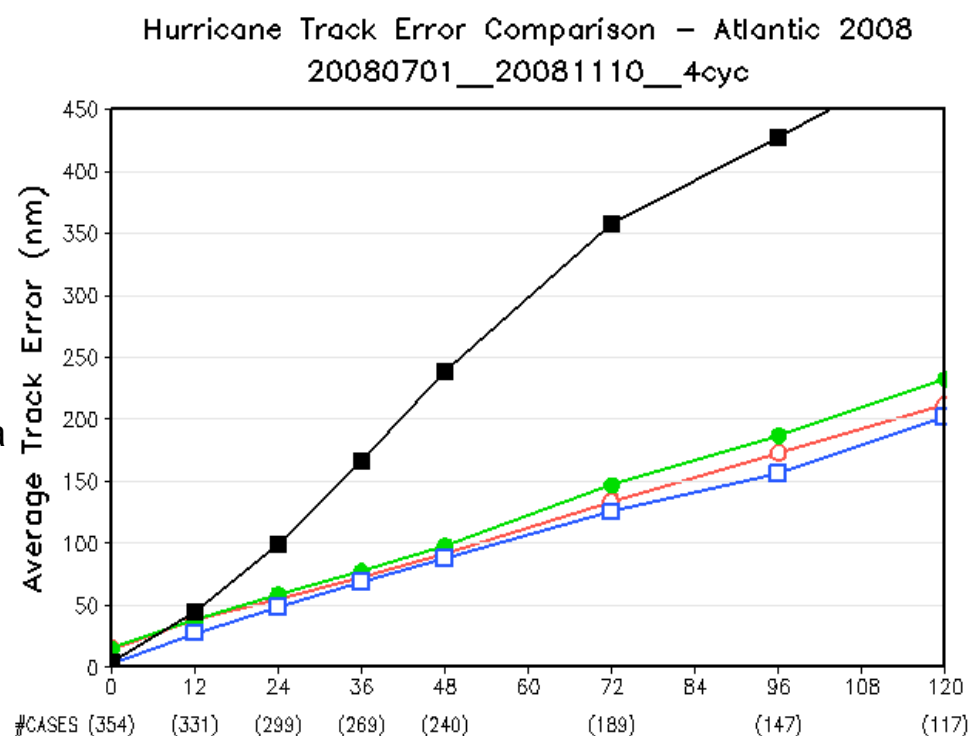
## □ Implementing improved techniques in GSI analysis.

- Use uniform thinning mesh for brightness temp data
- Improvements to assimilation of GPS RO data (QC, retune ob errors, improved forward operator )
- Add dry mass pressure constraint
- Merge GMAO & EMC codes for 4d-var capability
- Update background error covariance
- Proper use of different spectral truncation between background and analysis

## □ Benefits

- **Improved GFS tropical storm track & intensity forecasts**
- Small improvement in global forecast accuracy

## 2008 Hurricane Season



GSI/GFS Bundle – Red  
Operational GFS - Green



# **Time and Resources Consumed for GFS/GSI December 2009 Implementation**



- **17 months required to develop, test and implement**
- **119 person months of effort (EMC, NCO, GFDL, TPC, SPC, HPC, AWC)**
- **17 months of continuous cycles 4/day with 16 day forecasts retrospective/real-time testing conducted for GFS/GSI**
- **500 HWRF and 600 GFDL TC/Hurricane cases simulated**
- **1000 Node hours and 75 TB of disk consumed**



# Challenges Associated with Working with Testbeds

(Specific to NCEP Operational Modeling systems)

- **Modeling is a common thread between NOAA testbeds**
  - JHT, HMT, HWT, JCSDA, etc.
- **Each testbed has unique characteristics**
  - Mission
  - Governance and management structure
  - Funding sources and profiles
  - Computational assets
  - Interaction mechanisms with external community (immersion vs virtual)
  - Metrics for success (pubs, operational implementations, training modules, etc.)
- **Scientific stewardship**
- **Collaboration within a secure IT environment**
- **Disciplined code management practice**
- **Rigorous testing and evaluation required**
- **Must fit into NCEP operational implementation process**



# Mapping Testbeds Into the EMC Organizational Structure



EMC Team/Branch	JHT	CTB	HWT	HMT	AWC	DTC	JCSDA	OSSE	OPG
Global Weather and Climate		X		X			X	X	
Mesoscale			X	X	X	X		X	
Marine		X							
Climate		X							
Data Assimilation			X	X	X	X	X	X	
Hurricanes	X					X			
Land Surface	X	X	X				X		
Ensembles		X	X	X	X	X			

- Alignment between testbed and NCEP/EMC missions is critical to success
- Some testbeds are able to provide support to NCEP staff to participate
- Land surface modeling team has been very successful working with NOAA/CPO outside the testbed system
- Data assimilation team is a core NCEP infrastructure



# Recommendations

(Specific to NCEP Operational Modeling systems)



- ❑ **Good communication is the key to success**
- ❑ **Exchange of staff with partner organization with long-term commitments:**
  - **DTC staff assigned to work at EMC (e.g., GSI, NEMS)**
  - **NWS/OST liaison at DTC**
- ❑ **Establish pre-implementation testing environment outside of EMC to help incorporate advances in operational systems**
- ❑ **Recognize, acknowledge and manage the different requirements (and constraints) of research and operational communities**
  - **Operations: robustness, efficiency, easy maintenance**
  - **Research: flexibility, multiple-choices, community support**



# Recommendations (Cont.)

## (Specific to NCEP Operational Modeling systems)



- ❑ **Promote an environment where collaboration will thrive**
  - **It's all about the people—the most valuable resource**
  - **Perceptions are important (listen & learn)**
  - **Shared vision and perception of “value added”**
  - **Motivation and morale critical to success of ANY organization**
  - **Metrics for success--seeking alignment between the research and operational communities (**within NOAA** and external to)**
    - ❖ **Peer-review publications a critical metric for research community (NOAA Labs)**
    - ❖ **Implementations a critical metric for EMC scientists**



## Summary



The “research to operations” process is:

**A partnership between researchers and users**

**WHO BOTH**

**expend nontrivial and sufficient resources toward realizing a product, process, or analytical objective.**



Utilizing unique space-based observations to improve short-term forecasting